International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Influence of IT innovation on the effectiveness of supply chain management among the manufacturing sectors in China

Emmanuel P. Paulino [1], Paulo Noel A. Mazo [2,*], Lou-Rena S. Boquila [3], Glessie M. Basa [4] and Anna Liza Aterrado [5]

[1] *College of Business Administration and Accountancy, De La Salle University.*
[2] *College of Business Administration in Pamantasan ng Lungsod ng Maynila (PLM).*
[3] *Assistant Professorial Lecturer II at the Pamantasan ng Lungsod ng Maynila.*
[4] *Pamantasan ng Lungsod ng Maynila. Eulogio "Amang" Rodriguez Institute of Science and Technology, Nagtahan St, Sampaloc, Manila, 1008 Metro Manila, +639173955188.*
[5] *Department of Program Chair of Marketing, College of Business Administration and Accountanc, De La Salle University Dasmarinas.*

International Journal of Science and Research Archive, 2025, 14(02), 105-123

Publication history: Received on 22 December 2024; revised on 29 January 2025; accepted on 01 February 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.14.2.0325

Abstract

This study examines the moderating role of IT innovation in the relationship between the four pillars of supply chain management—purchasing, demand forecasting, logistics, and customer service—and supply chain effectiveness in the manufacturing sector in Guangzhou, China. Using partial least squares structural equation modeling (PLS-SEM), the analysis demonstrates that purchasing, demand forecasting, logistics, and customer service significantly and positively impact supply chain effectiveness. IT innovation is found to significantly enhance these relationships, underscoring its critical role in optimizing supply chain operations. The findings highlight IT innovation as a key enabler of operational excellence, enhancing efficiency and responsiveness in supply chain processes. This research contributes to the theoretical understanding of IT-driven supply chain management and provides actionable insights for manufacturing firms aiming to maintain competitiveness in an evolving global market. Implications for theory development, management practice, and the manufacturing industry are discussed, along with recommendations for future research.

Keywords: Manufacturing Sector; IT Innovation, Supply Chain Effectiveness; Purchasing; Demand Forecasting; Logistics; Customer Service; Structural Equation Modeling

1. Introduction

China's manufacturing sector has long been a cornerstone of its economic growth, solidifying the nation's position as a global manufacturing powerhouse. In 2024, China's manufacturing output continued to expand, with the Manufacturing Purchasing Managers' Index (PMI) indicating a positive trend. The PMI, a key indicator of manufacturing activity, remained above the neutral 50-point mark, reflecting ongoing expansion in the sector (Asif, Yang, & Hashim, 2024). This expansion is further supported by the rise of digital transformation, corporate culture, and leadership in improving corporate sustainable performance (Xie, Zheng, Li, Wang, & Wang, 2024). Additionally, the shift toward energy-saving-biased technological progress is playing a critical role in the sector's evolution (Lyu, Pang, & Xu, 2024).

Despite this growth, the sector faces several significant challenges. The ongoing housing market crisis has dampened domestic demand, affecting consumer spending and, consequently, manufacturing output (Abam, Inah, & Nwankwojike, 2024). Furthermore, the trend toward near-shoring, where companies relocate manufacturing closer to their home countries, has led to increased competition from emerging manufacturing economies such as India and Vietnam (Yao &

* Corresponding author: Paulo Noel A. Mazo.

Jin, 2024). Additionally, rising labor costs in China have prompted many manufacturers to consider relocating to other countries in Southeast Asia, seeking more cost-effective production options (Li, Zhang, & Li, 2024). These factors collectively pose significant challenges to China's manufacturing sector, necessitating strategic adaptations to maintain its competitive edge.

The role of key variables such as IT innovation, supply chain management, and operational effectiveness is becoming increasingly pivotal as manufacturing firms face evolving demands. IT innovation, particularly in the context of digital transformation, has been linked to improvements in the efficiency and responsiveness of supply chain operations. Previous studies highlight the positive influence of IT innovations, such as automation, data analytics, and real-time monitoring systems, in optimizing processes like purchasing, demand forecasting, logistics, and customer service (Xie et al., 2024). However, findings regarding the exact impact of these innovations on supply chain effectiveness have been mixed. Some studies show strong positive relationships, suggesting that IT innovation enhances supply chain flexibility and responsiveness (Li et al., 2024), while others indicate that the benefits of IT adoption are contingent on factors such as firm size, management commitment, and the specific technological capabilities integrated (Yao & Jin, 2024). Additionally, IT innovation's moderating effect on supply chain functions, such as its enhancement of logistics operations and customer service, has been supported in some studies (Xie et al., 2024), but other research presents conflicting results, suggesting that the benefits of IT adoption are less pronounced in sectors where traditional manufacturing processes dominate.

Furthermore, despite the increasing focus on IT innovation and its role in improving supply chain effectiveness, there remains a gap in understanding the full extent of this influence, particularly in the context of China's manufacturing sector. While previous studies have examined individual variables like IT innovation, supply chain management, and operational effectiveness, few have explored their interconnectedness and the specific moderating effect of IT innovation on the relationship between various supply chain functions and overall supply chain effectiveness. Moreover, the conflicting results in previous studies about the direct and indirect effects of each variable underscore the need for further investigation. Some studies suggest a strong positive relationship between IT innovation and supply chain efficiency (Xie et al., 2024), while others point to more nuanced or weaker effects depending on contextual factors such as technological infrastructure, organizational culture, and the strategic focus of the firm (Yao & Jin, 2024). This gap calls for more comprehensive research that delves deeper into how IT innovation impacts various facets of supply chain management in the manufacturing sector, accounting for contextual differences and moderating factors, to provide clearer insights and actionable recommendations for practitioners.

2. Literature Review

2.1. Supply chain management

Supply chain management (SCM) is the process of managing the flow of goods, information, and money from suppliers to customers (Shou et al. 2019). It aims to make operations more efficient, reduce costs, and improve customer satisfaction. Kähkönen and Patrucco (2022) emphasize that managing purchases and supplies is essential for handling crises. Srai and Lorentz (2019) explain how digital technology has made supply chains more connected and efficient. Murfield, Ellram, and Giunipero (2021) highlight the need to focus on sustainability and value creation instead of just cutting costs.

In the manufacturing sector, SCM ensures that raw materials are procured, processed, and delivered as finished goods to customers in a timely and cost-effective manner. It plays a critical role in maintaining operational efficiency and meeting production schedules. Griffin, Gaustad, and Badami (2019) highlight the importance of managing critical materials to avoid production delays. Effective SCM in manufacturing relies on technologies like automation and data analytics, as discussed by Flechsig, Anslinger, and Lasch (2022), which streamline processes and reduce errors (Juettner et al. 2020).

SCM relies on four main pillars: purchasing, demand forecasting, logistics, and customer service. Purchasing involves buying the right materials effectively, as explained by Bals et al. (2019). Demand forecasting helps predict customer needs, preventing waste and ensuring resources are available (Srai & Lorentz, 2019). Logistics ensures products are delivered on time and cost-effectively (Schaffer & Ray, 2020). Customer service focuses on meeting customer expectations and building loyalty (van Hoek et al., 2020). These pillars work together to make supply chains reliable and competitive in a fast-changing world.

2.1.1. Purchasing

Purchasing is the process of buying goods and services to meet specific needs. It is essential in supply chain management because it ensures that the right materials are available at the right time and cost. Benton Jr. (2020) explains that purchasing helps organizations improve efficiency and reduce costs. Modern purchasing uses tools like artificial intelligence to make better decisions and streamline processes, as highlighted by Allal-Chérif, Simón-Moya, and Ballester (2021). Factors such as pricing (Ali & Anwar, 2021), storytelling (Júnior et al., 2023), and digital marketing (Al-Azzam & Al-Mizeed, 2021) influence purchasing decisions. Additionally, green purchasing (Hazaea et al., 2022) and social public purchasing (Hafsa, Darnall, & Bretschneider, 2022) reflect the growing importance of sustainability and ethical practices.

In the manufacturing sector, purchasing focuses on obtaining raw materials, parts, and tools needed for production. Schiele (2019) emphasizes its role in keeping production running smoothly. Good purchasing strategies help lower costs, ensure quality, and promote sustainability. Johnsen et al. (2022) highlight how purchasing supports product innovation, while Xu, Prybutok, and Blankson (2019) discuss the importance of environmental awareness in manufacturing procurement. Trust and supplier service quality also play a big role in purchasing decisions in manufacturing (Rivaldo & Amang, 2022). Overall, purchasing in manufacturing ensures efficient operations and supports both innovation and sustainability.

2.1.2. Demand forecasting

Demand forecasting involves predicting future customer demand for goods or services using historical data, statistical methods, and advanced technologies like machine learning. It plays a vital role in decision-making across industries, as it helps optimize resource allocation, minimize inventory costs, and improve service levels (Seyedan & Mafakheri, 2020). Advanced approaches such as deep learning (Kilimci et al., 2019) and Long Short-Term Memory (LSTM) networks (Abbasimehr et al., 2020) have improved forecasting accuracy by capturing complex patterns in demand data. Demand forecasting also considers external factors like promotions (Abolghasemi et al., 2020), calendric events (Huber & Stuckenschmidt, 2020), and demand volatility. These tools and methods enable businesses to anticipate market trends and make informed decisions.

In the manufacturing sector, demand forecasting ensures efficient production planning, inventory management, and supply chain coordination. Accurate forecasts help manufacturers reduce production delays, optimize capacity, and maintain cost efficiency (Feizabadi, 2022). For example, predictive analytics can enhance supply chain performance by identifying demand fluctuations (Johannesen, Kolhe, & Goodwin, 2019). In specific industries, such as pharmaceuticals, forecasting models are tailored to meet sector-specific needs, such as managing perishable products and responding to sudden demand changes (Merkuryeva, Valberga, & Smirnov, 2019). By incorporating advanced techniques like Bayesian deep learning (Kulshrestha, Krishnaswamy, & Sharma, 2020) and machine learning (Law et al., 2019), manufacturers can align production with market needs and adapt to dynamic environments effectively.

2.1.3. Logistics

Logistics is the process of planning, implementing, and controlling the efficient flow of goods, services, and information from the point of origin to the point of consumption to meet customer requirements. It encompasses transportation, warehousing, inventory management, and distribution, all aimed at achieving operational efficiency and customer satisfaction (Harrison et al., 2019; Bowersox et al., 2020). Logistics has evolved with the introduction of advanced technologies such as blockchain, drones, and automation, which improve traceability, speed, and overall efficiency (Tijan et al., 2019; Sah et al., 2021). The concept of Logistics 4.0 integrates these technologies within the framework of Industry 4.0, enabling smarter, interconnected systems for managing supply chain processes (Winkelhaus & Grosse, 2020; El Hamdi & Abouabdellah, 2022).

Logistics plays a critical role in ensuring smooth operations and competitive advantage. Manufacturing logistics focuses on the efficient transportation of raw materials, seamless integration of production and distribution, and minimizing bottlenecks in supply chain networks (Nechaev et al., 2021; Onstein et al., 2019). The adoption of Logistics 4.0 technologies, such as automation and predictive analytics, enhances productivity and flexibility in production processes (Tang & Veelenturf, 2019; Sgarbossa et al., 2020). Additionally, logistics centers are evolving into smart hubs, equipped with interconnected systems and real-time data to optimize storage and distribution activities (Yavas & Ozkan-Ozen, 2020). These advancements enable manufacturers to address market demands more effectively while maintaining cost efficiency and sustainability.

2.1.4. Supply Chain Effectiveness

Supply chain effectiveness refers to the capacity of supply chain systems to meet organizational objectives by ensuring seamless operations, reducing risks, and delivering value to stakeholders. It involves aligning supply chain activities with business goals to optimize performance, increase responsiveness, and meet customer demands (Li, 2022). Effective supply chains integrate customer relationship management, competent human resources, and robust internal control systems to enhance operations and reduce inefficiencies (Astuty et al., 2021). Moreover, strategies such as supply chain finance, risk management, and advanced decision-support tools significantly contribute to building resilient and efficient supply chains (Nguyen et al., 2022; Okoye et al., 2024).

Supply chain effectiveness is pivotal for achieving operational efficiency, minimizing risks, and sustaining competitiveness. Manufacturers leverage supply chain finance to improve liquidity and reduce vulnerabilities (Ali et al., 2019; Beka Be Nguema et al., 2021). Advanced technologies such as the metaverse are increasingly adopted to streamline processes, enhance collaboration, and boost performance (Alshurideh et al., 2024). Additionally, vulnerability mitigation strategies and a strong risk culture help manufacturers navigate uncertainties while ensuring stable and efficient supply chain operations (Kurniawan et al., 2017). Effective practices such as structural modeling of supply chain factors further enable small and medium enterprises (MSMEs) to address sector-specific challenges and achieve operational excellence (Mulchandani et al., 2023).

2.1.5. IT Innovation

IT innovation refers to the creation, adoption, and integration of new information technologies to enhance processes, products, and services, ultimately driving organizational growth and performance. It enables businesses to streamline operations, improve decision-making, and adapt to dynamic market demands (Chege et al., 2020; Sutrisno et al., 2023). IT innovation also fosters entrepreneurial activities, job creation, and collaborative networks, particularly for SMEs in developing countries (Chege & Wang, 2020). Leadership, such as CEOs with IT expertise, plays a critical role in promoting digital innovation by shaping organizational culture and strategy (Zhao et al., 2024). Furthermore, collaboration within supply chains and harmonized IT affordances significantly enhance an organization's innovative capabilities (Jimenez-Jimenez et al., 2019; Chatterjee et al., 2020).

IT innovation is a vital enabler of operational efficiency, product quality, and sustainability on the manufacturing sector. Manufacturers leverage IT to achieve supply chain collaboration, optimize production processes, and address environmental challenges such as greenhouse gas emissions (Miśkiewicz, 2021). IT innovation also facilitates internationalization for SMEs by reducing barriers and enhancing competitive advantage in global markets (Lecerf & Omrani, 2020). Moreover, health-related manufacturing benefits from IT-driven digital solutions, promoting advancements in care systems and knowledge sharing (Cresswell & Sheikh, 2013; Sheikh et al., 2021). The integration of IT with innovative practices thus serves as a cornerstone for transforming the manufacturing landscape and ensuring adaptability in evolving markets.

2.1.6. Theory

To provide a comprehensive understanding of how IT innovation influences the effectiveness of supply chain management, this study adopts two pivotal theories: the Resource-Based View (RBV) and the Technology-Organization-Environment (TOE) Framework.

The Resource-Based View, as conceptualized by Barney (1991) and further developed by Kozlenkova, Samaha, and Palmatier (2021), emphasizes the strategic importance of internal resources and capabilities in achieving competitive advantage. This theory asserts that firms with valuable, rare, inimitable, and non-substitutable resources can outperform their competitors (Barney et al., 2012). In the context of IT innovation, RBV highlights the role of advanced technological assets and skilled human resources in enhancing supply chain integration, collaboration, and performance (Chege & Wang, 2020). Recent studies by Kero and Bogale (2023) and Kozlenkova et al. (2021) further validate the relevance of RBV in analyzing how IT-driven innovations such as automation and data analytics optimize resource allocation, reduce costs, and improve operational efficiency in supply chain management.

Complementing this, the Technology-Organization-Environment (TOE) Framework provides a holistic perspective on the adoption and implementation of IT innovation. Originally proposed by Tornatzky and Fleischer (1990), this framework emphasizes that technological advancements, organizational readiness, and external environmental pressures collectively influence technology adoption (Baker, 2020). The TOE Framework posits that supply chain effectiveness is driven not only by the availability of technology but also by organizational factors such as leadership, culture, and strategic alignment, as well as external factors like market demands and regulatory requirements (Yunis,

Tarhini, & Kassar, 2022). Studies by Satyro et al. (2024) and Zhao et al. (2024) highlight that aligning IT innovation with organizational objectives and environmental conditions fosters enhanced agility, resilience, and sustainability in supply chains.

2.2. Hypothesis

2.2.1. Purchasing Linked with Supply Chain Effectiveness

Purchasing plays a significant role in enhancing supply chain effectiveness, particularly in the manufacturing sector. The literature reveals several perspectives on the connection between purchasing and supply chain outcomes. According to Hazaea et al. (2022), green purchasing practices, which focus on environmentally responsible procurement decisions, are essential in improving the sustainability and long-term effectiveness of supply chains. Their research suggests that adopting sustainable purchasing practices contributes positively to the operational efficiency of manufacturing firms by aligning procurement strategies with environmental and social responsibilities. Additionally, Alshurideh et al. (2024) argue that incorporating emerging technologies like the metaverse can streamline purchasing processes, thereby improving supply chain effectiveness through enhanced communication, data management, and decision-making.

Contrasting with these findings, Kurniawan et al. (2017) observed that while purchasing decisions are crucial for supply chain performance, risk mitigation strategies, such as diversification of suppliers, can sometimes complicate purchasing practices. This diversification can increase supply chain complexity, particularly when managing a larger pool of suppliers, and may not always lead to the desired improvements in effectiveness. Moreover, Júnior et al. (2023) emphasized that while consumer purchasing behavior is influenced by various marketing factors, it is not always the purchasing decisions themselves that improve supply chain performance, but rather how those decisions align with broader supply chain management strategies and the level of innovation incorporated into purchasing processes. This hypothesis is thus developed based on the comprehension of the debate above:

H1: Purchasing has a significant effect on supply chain effectiveness

2.2.2. Demand Forecasting Linked with Supply Chain Effectiveness

Demand forecasting is another critical element affecting the effectiveness of supply chains in the manufacturing sector. Li (2022) and Abbasimehr et al. (2020) underscore that accurate demand forecasting, powered by advanced technologies such as decision support systems and machine learning, significantly boosts supply chain effectiveness by enabling manufacturers to anticipate customer needs, optimize inventory management, and minimize costs. Their studies suggest that improved forecasting systems lead to a more agile and responsive supply chain, enhancing overall operational efficiency.

However, studies by Huber & Stuckenschmidt (2020) and Kilimci et al. (2019) present a more nuanced view, suggesting that while demand forecasting models can improve efficiency, the inherent volatility in demand, especially in industries susceptible to rapid changes in consumer behavior, can undermine their effectiveness. They argue that demand forecasting models based on past data and machine learning algorithms can sometimes fail to account for sudden shifts in market trends, leading to inaccurate predictions and reduced supply chain performance. Additionally, Nguyen et al. (2022) highlighted that in the context of small and medium-sized enterprises (SMEs) in manufacturing, reliance on demand forecasting often conflicts with their limited technological capabilities, ultimately hindering supply chain efficiency.

H2: Demand Forecasting has a significant effect on supply chain effectiveness

2.2.3. Logistics Linked with Supply Chain Effectiveness

The role of logistics in improving supply chain effectiveness in manufacturing firms has been explored extensively in recent years. Yavas & Ozkan-Ozen (2020) highlight that the integration of Industry 4.0 technologies in logistics—such as automation, robotics, and IoT—can significantly improve efficiency by reducing lead times and enhancing coordination across the supply chain. They argue that logistics centers that adopt smart technologies can streamline the flow of goods, reduce errors, and ultimately drive supply chain effectiveness.

On the contrary, Sah et al. (2021) emphasize the barriers to implementing advanced logistics technologies, such as drone delivery systems, in certain manufacturing environments. They note that despite the potential benefits, technological adoption in logistics may face resistance due to high initial costs, regulatory concerns, and operational complexities.

Similarly, Nechaev et al. (2021) argue that logistical inefficiencies, such as outdated infrastructure or inefficient transportation networks, can negate the positive impact of advanced technologies, particularly in regions with limited access to high-tech logistics solutions. Thus, this hypothesis is derived from an understanding of the aforementioned debate:

H3: Logistics has a significant effect on supply chain effectiveness

2.2.4. Customer Service Linked with Supply Chain Effectiveness

Customer service has a significant impact on the effectiveness of supply chains, as it directly influences customer satisfaction, retention, and overall supply chain responsiveness. Sheehan et al. (2020) and Nyagadza et al. (2024) explore the role of customer service technologies, particularly chatbots, in improving customer interactions and service efficiency. Their findings suggest that the integration of AI-driven customer service solutions can help manufacturers respond more quickly to customer inquiries, resolve issues efficiently, and improve the overall customer experience, thereby enhancing supply chain effectiveness.

However, Rita et al. (2019) and Wilson et al. (2020) argue that the over-reliance on automated customer service systems, such as chatbots, could lead to a reduction in the personalized experience that some customers expect, particularly in high-touch industries like manufacturing. They contend that while AI solutions improve efficiency, they may compromise the quality of customer service, especially when complex problems require human intervention. This lack of personal interaction may harm the customer experience and, consequently, the effectiveness of the overall supply chain.

H4: Customer Service has a significant effect on supply chain effectiveness

2.2.5. IT Innovation as Moderator

Chege, Wang, and Suntu (2020) explore how IT innovation moderates the relationship between resource management and firm performance. Their findings in the Kenyan context suggest that firms leveraging IT innovation experience enhanced decision-making, streamlined operations, and increased productivity. This moderating effect occurs as IT innovation integrates with existing systems to optimize resource utilization, thus amplifying the positive impact of effective resource management on firm performance (Sutrisno et al., 2023; Miśkiewicz, 2021).

Similarly, Zhao et al. (2024) emphasize the influence of leadership on IT innovation as a moderating factor. The study highlights that CEOs with IT expertise strengthen the link between organizational innovation initiatives and financial outcomes. This leadership-driven IT adoption ensures that innovation aligns with strategic goals, enhancing the relationship between organizational innovation and performance metrics (Chatterjee et al., 2020).

Jimenez-Jimenez, Martínez-Costa, and Sanchez Rodriguez (2019) examine the role of IT innovation in moderating the relationship between supply chain collaboration and firm innovation. They found that IT innovation facilitates real-time data sharing, process synchronization, and enhanced communication, which strengthen collaboration among supply chain partners. As a result, the synergistic effect of collaboration on innovation is magnified, particularly in complex manufacturing environments (Lecerf & Omrani, 2020).

H5: Use of IT moderates the relationship between four pillars and supply chain effectiveness.

3. Methodology

3.1. Research Participants and Data

The respondents for this study were selected from manufacturing companies located in Guangzhou, China. Only manufacturing companies that have been in operation for at least three years were included in the study, while those operating for less than three years were excluded. The respondents comprised top managers and executives from the manufacturing sector within the Guangzhou area.

The number of samples is a minimum of 124 respondents based on the priori statistical power analysis using G Power with power = .80(1 – β), effect size = .25, and α = .05. Statistical power analysis is the appropriate method in computing for the sample size if the goal is to accept or reject any hypothesis (Cohen, 1992; Jobst et al., 2023).

3.2. Instrumentation

The survey questionnaire served as the primary data collection instrument for this study. Likert scale items were designed based on insights and frameworks established in previous literature to ensure the accurate measurement of each construct. Table I provides a detailed overview of the constructs and their corresponding measurement items.

Table 1 Likert Scale Items

Variables/Constructs	Questionnaire Items / Indicators	Source
Purchasing	Specific information technology innovation support or enhance order processing, invoicing and settling accounts with our major supplier. Innovation on information technology has shorten the length of the supply chain process. We and our main supplier are able to cope with changes brought about by the supply chain disruptions due to innovations on IT. We are able to maintain a high order-fill rate from our supplier due to IT innovations	Allal-Chérif, Simón-Moya, & Ballester, (2021). Benton (2020).
Demand Forecasting	Our supply chain has the ability to quickly modify products to meet customer requirements due to IT innovations Due to IT innovations our supply chain allows us to quickly introduce new products into our markets. IT innovations support our leveraging of customer's expertise to create new business opportunities.	Seyedan & Mafakheri, (2020). Feizabadi, (2022).
Logistics	IT innovation support task of managing warehouse stock and inventories with our major customers. IT innovation support our exchange of shipment and delivery information with our major customers. IT innovation support for our daily work such as documentation, processing with our major customers. Our supply chain because of IT innovation were able to make deliveries in full and on-time.	Yavas & Ozkan-Ozen, (2020). Winkelhaus & Grosse, (2020).
Customer Service	IT innovations supports the company understand trends in customer preferences. IT innovations base support help us coordinate with our major customers. Specific IT innovations support the company integration effort with major customers. IT innovation support leveraging of our customer's expertise to create new business opportunities.	Lee & Lee, (2020). Rita, Oliveira, & Farisa, (2019).
Supply Chain Effectiveness	We have multiple supply sources for most purchased items. We are able to replace one supply source for another in a short time. Our major suppliers are willing to accommodate changes that we have requested. We have strategic goals of investing in major suppliers to increase their capabilities.	Li, (2022). Ali, Gongbing, & Mehreen, (2019).

The questionnaire items were designed to measure each construct or latent variable that was defined in the conceptual framework using a 4-point Likert scale. The degree to which respondents agree with each of these claims determines how they rate it (Hair et al., 2011).

3.3. Statistical Treatment

The partial least squares structural equation modeling (PLS-SEM) approach was employed in this study, following the guidelines and recommendations of Hair et al. (2022). Initially, the measurement model was evaluated to assess the construct validity and reliability, ensuring the robustness of the constructs. Subsequently, the structural model was developed by examining both the direct and indirect effects among the variables, as outlined by Hair et al. (2011). This two-step procedure ensured a comprehensive analysis of the hypothesized relationships and the moderating effects within the model.

4. Data Analysis

4.1. Measurement Model Evaluation

Construct Validity and Scale Reliability

Table 2 Construct Validity and Scale Reliability

Construct	Items	Cronbach's α	Loadings	Ave. Var. Ext.
Purchasing	1	0.816	0.854	0.729
	2		0.869	
	3		0.799	
	4		0.89	
Demand Forecasting	1	0.795	0.759	0.681
	2		0.876	
	3		0.837	
Logistics	1	0.829	0.883	0.677
	2		0.763	
	3		0.859	
	4		0.779	
Customer Service	1	0.844	0.836	0.629
	2		0.711	
	3		0.732	
	4		0.881	
Supply Chain Effectiveness	1	0.86	0.811	0.575
	2		0.705	
	3		0.714	
	4		0.798	

Note: All loadings have a p-value of <.001.

The reliability and convergent validity test results are shown in Table 2. All survey items measuring each construct considerably exceeded the required Cronbach's coefficient value of at least 0.70. This evidence the reliability of each construct.

In establishing convergent validity, the standard is that all loadings and all Average Variance Extracted (AVE) should be =>0.50. Based on the analysis, the relevant constructs' items exceed these standards. As a result, these items were valid in measuring each construct.

4.2. Structural Model Evaluation

4.2.1. Structural Path Results

Table 3 Structural Path Results

Path	Estimate	SE	z	p	Interpretation
Purchasing to Supply Chain Effectiveness	0.8345	0.0298	27.999	< .001	H1 Accepted
Demand Forecasting to Supply Chain Effectiveness	0.5270	0.0624	8.44	< .001	H2 Accepted
Logistics to Supply Chain Effectiveness	0.4259	0.0398	10.7	< .001	H3 Accepted
Customer Service to Supply Chain Effectiveness	0.4518	0.0376	12.03	< .001	H4 Accepted

Table 3 shows the regression path results. The findings indicate that purchasing positively affects supply chain effectiveness (ß = 0.8345; p < .001). This suggests that for every 1-level increase in purchasing, supply chain effectiveness is expected to increase by 0.8345. Thus, H1 is accepted.

The results show that demand forecasting positively affects supply chain effectiveness (ß = 0.5270; p < .001). This implies that a 1-level increase in demand forecasting is associated with a 0.5270 increase in supply chain effectiveness. Therefore, H2 is accepted.

The analysis demonstrates that logistics significant affects the supply chain effectiveness positively (ß = 0.4259; p < .001). A 1-level increase in logistics predicts a 0.4259 increase in foreign supply chain effectiveness. Thus, H3 is accepted.

The findings reveal that customer service positively affects supply chain effectiveness (ß = 0.4518; p < .001). A 1-level increase in customer service is associated with a 0.4518 increase in supply chain effectiveness. H4 is accepted.

4.3. Moderating Effect of the IT Innovation between Four pillars of Supply Chain Management and Supply Chain Effectiveness

Table 4 Results of the moderating effect of the IT Innovation between Four pillars of Supply Chain Management and Supply Chain Effectiveness

Path	Estimate	SE	z	p	Interpretation
Purchasing ✻ IT Innovation	0.2654	0.0209	0.382	0.006	H5 Accepted
Demand Forecasting ✻ IT Innovation	0.126	0.0382	3.31	< .001	
Logistics ✻ IT Innovation	0.0722	0.0247	2.92	0.003	
Customer Service ✻ IT Innovation	0.0834	0.0236	3.53	< .001	

The results in Table 4 reveal that IT Innovation significantly moderates the relationship between the four pillars of Supply Chain Management—Purchasing, Demand Forecasting, Logistics, and Customer Service—and Supply Chain Effectiveness. Specifically, the moderating effect of IT Innovation on the relationship between Purchasing and Supply Chain Effectiveness is positive and significant (ß = 0.2654, p = 0.006), indicating that IT Innovation strengthens the impact of Purchasing on Supply Chain Effectiveness. Similarly, IT Innovation significantly enhances the relationship between Demand Forecasting and Supply Chain Effectiveness (ß = 0.126, p < 0.001), demonstrating its critical role in improving the predictive capabilities of demand forecasts.

Furthermore, the moderating effect of IT Innovation on the Logistics-Supply Chain Effectiveness relationship is also significant (ß = 0.0722, p = 0.003), highlighting the importance of IT Innovation in optimizing logistics operations. Lastly, IT Innovation significantly moderates the relationship between Customer Service and Supply Chain Effectiveness (ß=

0.0834, $p < 0.001$), emphasizing its role in enhancing customer service processes. These findings collectively suggest that IT Innovation is a critical enabler, enhancing the effectiveness of various supply chain functions. H5 is accepted.

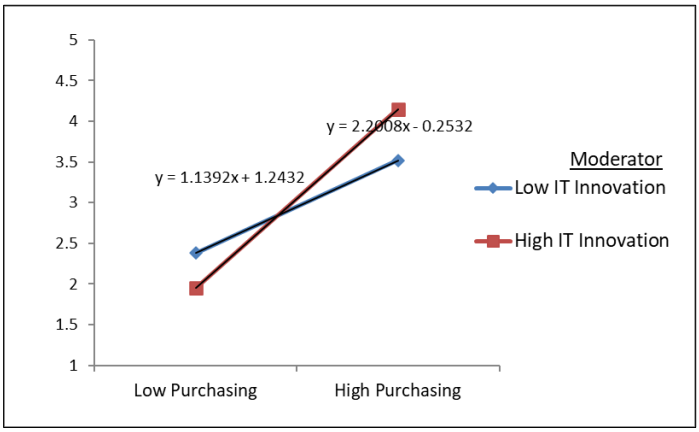

Figure 1 Simple Slope Analysis of the Moderating Effect of IT Innovation on the relationship between Purchasing and Supply chain effectiveness

The graph illustrates a moderation analysis examining how the relationship between Purchasing and Supply Chain Effectiveness is influenced by the level of IT Innovation (moderator). Two lines, representing low and high levels of IT Innovation, show differing relationships between Purchasing and Supply Chain Effectiveness.

For low IT Innovation (blue line), the relationship between Purchasing and Supply Chain Effectiveness is relatively weak but positive. The slope equation, $y = 1.1392x + 1.2432$, indicates that for every 1-unit increase in Purchasing, Supply Chain Effectiveness increases by 1.1392 units. While this shows a positive effect, the slope is relatively moderate, suggesting that when IT Innovation is low, improvements in Purchasing have a moderate, but not highly impactful, effect on Supply Chain Effectiveness.

In contrast, for high IT Innovation (red line), the relationship between Purchasing and Supply Chain Effectiveness is significantly stronger. The slope equation, $y = 2.2008x - 0.2532$, indicates that for every 1-unit increase in Purchasing, Supply Chain Effectiveness increases by 2.2008 units. This represents a much steeper slope, signifying that when IT Innovation is high, improvements in Purchasing have a more pronounced and impactful effect on Supply Chain Effectiveness.

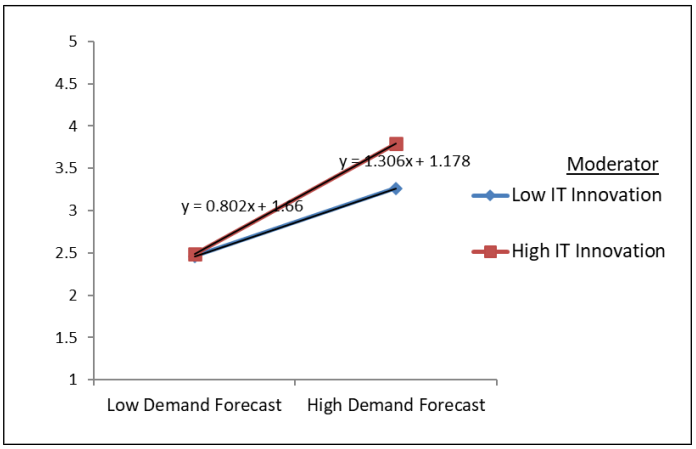

Figure 2 Simple Slope Analysis of the Moderating Effect of IT Innovation on the relationship between Demand Forecasting and Supply chain effectiveness

The graph illustrates a moderation analysis examining how the relationship between Demand Forecasting and Supply Chain Effectiveness is influenced by the level of IT Innovation (moderator). Two lines, representing low and high levels of IT Innovation, show differing relationships between Demand Forecasting and Supply Chain Effectiveness.

For low IT Innovation (blue line), the relationship between Demand Forecasting and Supply Chain Effectiveness is positive but relatively weak. The slope equation, y = 0.802x + 1.66, indicates that for every 1-unit increase in Demand Forecasting, Supply Chain Effectiveness increases by 0.802 units. While this represents a positive relationship, the slope is moderate, suggesting that when IT Innovation is low, improvements in Demand Forecasting have a moderate effect on enhancing Supply Chain Effectiveness.

In contrast, for high IT Innovation (red line), the relationship between Demand Forecasting and Supply Chain Effectiveness is significantly stronger. The slope equation, y = 1.306x + 1.178, indicates that for every 1-unit increase in Demand Forecasting, Supply Chain Effectiveness increases by 1.306 units. This represents a steeper slope, highlighting that when IT Innovation is high, improvements in Demand Forecasting lead to a more pronounced and impactful increase in Supply Chain Effectiveness.

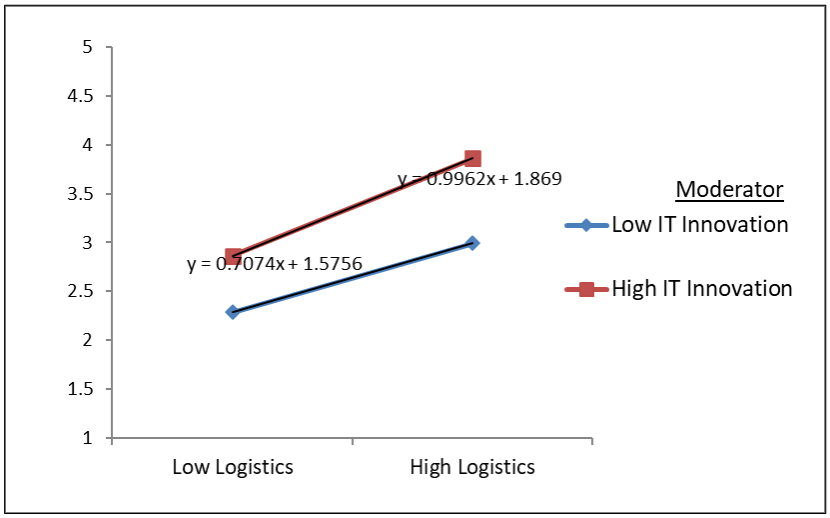

Figure 3 Simple Slope Analysis of the Moderating Effect of IT Innovation on the relationship between Logistics and Supply chain effectiveness

The graph illustrates a moderation analysis examining how the relationship between Logistics and Supply Chain Effectiveness is influenced by the level of IT Innovation (moderator). Two lines, representing low and high levels of IT Innovation, show differing relationships between Logistics and Supply Chain Effectiveness.

For low IT Innovation (blue line), the relationship between Logistics and Supply Chain Effectiveness is positive but relatively weak. The slope equation, y = 0.7074x + 1.5756, indicates that for every 1-unit increase in Logistics, Supply Chain Effectiveness increases by 0.7074 units. While this shows a positive effect, the slope is moderate, suggesting that when IT Innovation is low, improvements in Logistics have a moderate, but not highly impactful, effect on Supply Chain Effectiveness.

In contrast, for high IT Innovation (red line), the relationship between Logistics and Supply Chain Effectiveness is stronger. The slope equation, y = 0.9962x + 1.869, indicates that for every 1-unit increase in Logistics, Supply Chain Effectiveness increases by 0.9962 units. Although the slope is steeper than for low IT Innovation, it is still less pronounced compared to the impact seen in some other moderating conditions. This suggests that when IT Innovation is high, improvements in Logistics lead to a more significant enhancement of Supply Chain Effectiveness, but not as strongly as in cases with more pronounced moderating factors.

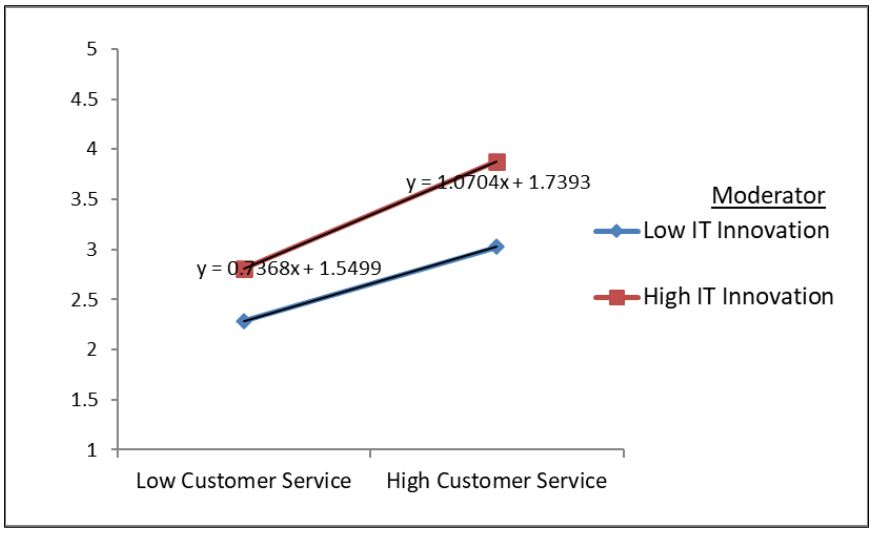

Figure 4 Simple Slope Analysis of the Moderating Effect of IT Innovation on the relationship between Customer Service and Supply chain effectiveness

The graph illustrates a moderation analysis examining how the relationship between Customer Service and Supply Chain Effectiveness is influenced by the level of IT Innovation (moderator). Two lines, representing low and high levels of IT Innovation, show differing relationships between Customer Service and Supply Chain Effectiveness.

For low IT Innovation (blue line), the relationship between Customer Service and Supply Chain Effectiveness is positive but relatively weak. The slope equation, $y = 0.7368x + 1.5499$, indicates that for every 1-unit increase in Customer Service, Supply Chain Effectiveness increases by 0.7368 units. While this represents a positive effect, the slope is moderate, suggesting that when IT Innovation is low, improvements in Customer Service have a moderate impact on enhancing Supply Chain Effectiveness.

In contrast, for high IT Innovation (red line), the relationship between Customer Service and Supply Chain Effectiveness is stronger. The slope equation, $y = 1.0704x + 1.7393$, indicates that for every 1-unit increase in Customer Service, Supply Chain Effectiveness increases by 1.0704 units. This represents a steeper slope compared to the low IT Innovation condition, signifying that when IT Innovation is high, improvements in Customer Service lead to a more substantial and impactful increase in Supply Chain Effectiveness.

5. Conclusion

5.1. Purchasing to Supply Chain Effectiveness

Purchasing significantly and positively influences supply chain effectiveness. Efficient procurement processes ensure the timely acquisition of raw materials and components, which are essential for uninterrupted production. Strategic sourcing and supplier relationship management directly contribute to operational efficiency and cost reduction. This aligns with existing research emphasizing the critical role of effective purchasing in manufacturing, where material quality and supplier reliability significantly impact overall performance (Kannan & Tan, 2018; Jin et al., 2022).

5.2. **Demand Forecasting to Supply Chain Effectiveness**

Demand forecasting is crucial for enhancing supply chain effectiveness in manufacturing. Accurate forecasts allow manufacturers to align production schedules with market demands, minimize excess inventory, and optimize resource allocation. This finding resonates with prior studies highlighting that robust demand forecasting capabilities are critical for reducing lead times and improving manufacturing agility (Chopra & Meindl, 2019; Wang et al., 2021). Effective forecasting enables manufacturers to respond proactively to market fluctuations, ensuring competitiveness.

5.3. Logistics to Supply Chain Effectiveness

Logistics plays a pivotal role in driving supply chain effectiveness within the manufacturing industry. Efficient logistics management ensures the seamless flow of materials from suppliers to production facilities and finished goods to customers. By reducing transit times and optimizing transportation routes, logistics can significantly enhance

operational efficiency. This conclusion aligns with earlier research emphasizing the importance of logistics in reducing costs and improving customer satisfaction in manufacturing supply chains (Christopher, 2016; Govindan et al., 2020).

5.4. Customer Service to Supply Chain Effectiveness

Customer service positively impacts supply chain effectiveness by fostering strong relationships with clients and meeting their expectations for timely and high-quality deliveries. In the manufacturing sector, superior customer service translates to improved brand reputation and loyalty, which are critical for maintaining long-term partnerships. This finding supports existing literature, which highlights the importance of customer-centric approaches in manufacturing supply chains to achieve a competitive edge (Homburg et al., 2018; Abolhassani et al., 2023).

5.5. Moderating effect of IT Innovation

The results highlight the significant role of IT Innovation in moderating the relationship between key pillars of Supply Chain Management—Purchasing, Demand Forecasting, Logistics, and Customer Service—and overall Supply Chain Effectiveness in the manufacturing sector.

5.6. IT Innovation and Purchasing

IT Innovation strengthens the impact of Purchasing on Supply Chain Effectiveness in manufacturing companies. Technologies such as e-procurement, supplier collaboration platforms, and automated purchasing systems can improve the efficiency and cost-effectiveness of procurement processes. This is particularly important in manufacturing, where timely access to high-quality materials at competitive prices directly influences production efficiency and product quality. This aligns with studies showing that IT innovations in purchasing processes help manufacturers reduce lead times, enhance supplier relationships, and streamline sourcing decisions (Chong et al., 2020; Lee et al., 2022).

5.7. IT Innovation and Demand Forecasting

The moderating effect of IT Innovation on the Demand Forecasting-Supply Chain Effectiveness relationship demonstrates how advanced IT tools—like predictive analytics, big data, and artificial intelligence (AI)—enhance the accuracy of demand forecasts in the manufacturing sector. IT innovation enables manufacturers to predict customer demand with greater precision, resulting in optimized inventory levels, reduced stockouts, and more responsive production schedules. These findings are in line with research showing that IT-based forecasting systems improve demand visibility and help manufacturers make more informed decisions, reducing operational inefficiencies (Hsu et al., 2019; Wang et al., 2021).

5.8. IT Innovation and Logistics

IT Innovation significantly moderates the relationship between Logistics and Supply Chain Effectiveness, reinforcing its importance in optimizing logistics operations within the manufacturing sector. Technologies such as real-time tracking systems, route optimization software, and automated warehouses improve the efficiency and reliability of transportation and distribution channels. These innovations help manufacturers reduce operational costs, ensure timely delivery of raw materials, and optimize the movement of finished goods. This finding supports the literature that emphasizes the role of IT in enhancing logistics operations, particularly in terms of cost reduction and improving supply chain responsiveness (Xu et al., 2020; Zohdi et al., 2021).

5.9. IT Innovation and Customer Service

The results indicate that IT Innovation moderates the relationship between Customer Service and Supply Chain Effectiveness. In manufacturing, customer service improvements driven by technologies such as Customer Relationship Management (CRM) systems, AI-powered chatbots, and automated service platforms enable more responsive and personalized interactions with customers. These technologies help manufacturers improve order accuracy, delivery schedules, and customer satisfaction, which are critical in maintaining competitive advantage. This finding is consistent with research showing that IT-enabled customer service tools enhance communication and service responsiveness, thereby contributing to supply chain effectiveness (Mollenkopf et al., 2018; Kim et al., 2021).

Implications

- For theory development

The study's findings contribute to the theoretical advancement of the Resource-Based View (RBV) and Technology-Organization-Environment (TOE) framework. The integration of IT Innovation with supply chain functions emphasizes

how technological capabilities enhance the strategic resources of manufacturing firms, aligning with RBV's notion that resources (like technology) contribute to competitive advantage. In this context, IT innovation is a critical resource that strengthens supply chain capabilities, driving operational effectiveness and organizational performance. The results also enhance the TOE framework by showing that the adoption of IT innovations in manufacturing is not only influenced by organizational characteristics (e.g., top management support, resources) but also by technological and environmental factors, thus offering a broader perspective on the factors that impact technology adoption in supply chain management. This integration advances our understanding of how technological resources and contextual factors interplay to shape supply chain effectiveness in the manufacturing industry.

- Business and management practice

The findings underscore the importance for manufacturing firms to embrace IT innovation as a strategic enabler to improve supply chain performance. Managers should invest in and prioritize IT systems that integrate purchasing, demand forecasting, logistics, and customer service functions to maximize operational efficiency. These technologies help streamline processes, reduce costs, and enhance flexibility in the face of market demands. Furthermore, managers should foster a culture of innovation within their organizations to encourage the adoption of digital tools that improve supply chain responsiveness. The insights from this study suggest that IT innovation should not be viewed as an isolated investment but as a critical component of an integrated business strategy that links technology adoption to overall business objectives and competitive advantage. By aligning IT innovation with operational practices, manufacturing companies can strengthen their supply chain effectiveness and improve customer satisfaction, ultimately leading to a more resilient and competitive position in the global market.

- Manufacturing Sector

The findings indicate that the manufacturing industry should prioritize the adoption and integration of IT innovations across critical supply chain functions to enhance overall supply chain effectiveness. Manufacturing firms must recognize that IT tools such as predictive analytics, automated logistics systems, and real-time inventory management can significantly optimize purchasing decisions, improve demand forecasting, streamline logistics, and enhance customer service. These innovations help companies reduce lead times, minimize inventory costs, and ensure that production schedules align with actual market demand. Additionally, the results suggest that manufacturing firms must continue to invest in emerging technologies to remain competitive in the ever-evolving global market. By integrating IT innovations into their supply chain management processes, manufacturers can improve operational efficiency, reduce costs, and improve their ability to respond to market changes, thus maintaining a strong competitive position and ensuring long-term sustainability in an increasingly technology-driven industry.

Compliance with ethical standards

Disclosure of conflict of interest

There is no potential conflict of interest to declare

Statement of ethical approval

The objectives, contents, and conclusion of this research were evaluated by a Research Ethics Board of a University and were found meritorious. No violations of research ethics standards were found, as the researchers were cautious and courteous in their data-gathering.

Statement of informed consent

Informed consent was secured from the participating companies before data gathering.

Availability of data and materials

Research data is gathered through an online survey which is available upon request.

Competing interests

The authors declare that they have no competing interests

Funding

This research has not been funded by any institution. It was the fruit of the collaborative effort of the contributors as part of their academic requirements.

References

[1] Abam, F. I., Inah, O. I., & Nwankwojike, B. N. (2024). Impact of asset intensity and other energy-associated CO2 emissions drivers in the Nigerian manufacturing sector: A firm-level decomposition (LMDI) analysis. Heliyon, 10(7).

[2] Abbasimehr, H., Shabani, M., & Yousefi, M. (2020). An optimized model using LSTM network for demand forecasting. *Computers & industrial engineering*, *143*, 106435. https://doi.org/10.1016/j.cie.2020.106435

[3] Abolghasemi, M., Beh, E., Tarr, G., & Gerlach, R. (2020). Demand forecasting in supply chain: The impact of demand volatility in the presence of promotion. *Computers & Industrial Engineering*, *142*, 106380. https://doi.org/10.1016/j.cie.2020.106380

[4] Adam, M., Wessel, M., & Benlian, A. (2021). AI-based chatbots in customer service and their effects on user compliance. Electronic Markets, 31(2), 427-445. https://doi.org/10.1007/s12525-020-00414-7

[5] Adebayo, V. I., Paul, P. O., & Eyo-Udo, N. L. (2024). The role of data analysis and reporting in modern procurement: Enhancing decision-making and supplier management. *GSC Advanced Research and Reviews*, *20*(1), 088-097. https://doi.org/10.30574/gscarr.2024.20.1.0246

[6] Al-Azzam, A. F., & Al-Mizeed, K. (2021). The effect of digital marketing on purchasing decisions: A case study in Jordan. *The Journal of Asian Finance, Economics and Business*, *8*(5), 455-463.

[7] Ali, B. J., & Anwar, G. (2021). Marketing Strategy: Pricing strategies and its influence on consumer purchasing decision. Ali, BJ, & Anwar, G.(2021). Marketing Strategy: Pricing strategies and its influence on consumer purchasing decision. International journal of Rural Development, Environment and Health Research, 5(2), 26-39. https://dx.doi.org/10.22161/ijreh.5.2.4

[8] Ali, Z., Gongbing, B., & Mehreen, A. (2019). Predicting supply chain effectiveness through supply chain finance: Evidence from small and medium enterprises. *The International Journal of Logistics Management*, *30*(2), 488-505. https://doi.org/10.1108/IJLM-05-2018-0118

[9] Allal-Chérif, O., Simón-Moya, V., & Ballester, A. C. C. (2021). Intelligent purchasing: How artificial intelligence can redefine the purchasing function. *Journal of Business Research*, *124*, 69-76. https://doi.org/10.1016/j.jbusres.2020.11.050

[10] Alshurideh, M., Kurdi, B., Yasin, S., Damra, Y., Al-Gasaymeh, A., Alzoubi, H., ... & Alquqa, E. (2024). Exploring the impact of metaverse adoption on supply chain effectiveness: A pathway to competitive advantage. *Uncertain Supply Chain Management*, *12*(2), 883-892. http://dx.doi.org/10.5267/j.uscm.2023.12.017

[11] Asif, M., Yang, L., & Hashim, M. (2024). The role of digital transformation, corporate culture, and leadership in enhancing corporate sustainable performance in the manufacturing sector of China. Sustainability, 16(7), 2651.

[12] Astuty, W., Zufrizal, Z., Pasaribu, F., & Rahayu, S. (2021). The effects of customer relationship management, human resource competence and internal control systems on the effectiveness of supply chain management in the Indonesian public sector. *Uncertain Supply Chain Management*, *9*(3), 595-602. http://dx.doi.org/10.5267/j.uscm.2021.6.001

[13] Bals, L., Schulze, H., Kelly, S., & Stek, K. (2019). Purchasing and supply management (PSM) competencies: Current and future requirements. *Journal of purchasing and supply management*, *25*(5), 100572. https://doi.org/10.1016/j.pursup.2019.100572

[14] Beka Be Nguema, J. N., Bi, G., Ali, Z., Mehreen, A., Rukundo, C., & Ke, Y. (2021). Exploring the factors influencing the adoption of supply chain finance in supply chain effectiveness: evidence from manufacturing firms. *Journal of Business & Industrial Marketing*, *36*(5), 706-716. https://doi.org/10.1108/JBIM-01-2020-0047

[15] Benton Jr, W. C. (2020). *Purchasing and supply chain management*. Sage Publications.

[16] Bowersox, D. J., Closs, D. J., Cooper, M. B., & Bowersox, J. C. (2020). *Supply chain logistics management*. Mcgraw-hill.

[17] Chatterjee, S., Moody, G., Lowry, P. B., Chakraborty, S., & Hardin, A. (2020). Information Technology and organizational innovation: Harmonious information technology affordance and courage-based actualization. *The Journal of Strategic Information Systems*, *29*(1), 101596. https://doi.org/10.1016/j.jsis.2020.101596

[18] Chege, S. M., & Wang, D. (2020). Information technology innovation and its impact on job creation by SMEs in developing countries: an analysis of the literature review. *Technology Analysis & Strategic Management*, *32*(3), 256-271. https://doi.org/10.1080/09537325.2019.1651263

[19] Chege, S. M., Wang, D., & Suntu, S. L. (2020). Impact of information technology innovation on firm performance in Kenya. *Information Technology for Development*, *26*(2), 316-345. https://doi.org/10.1080/02681102.2019.1573717

[20] El Hamdi, S., & Abouabdellah, A. (2022). Logistics: Impact of Industry 4.0. *Applied Sciences*, *12*(9), 4209. https://doi.org/10.3390/app12094209

[21] Feizabadi, J. (2022). Machine learning demand forecasting and supply chain performance. *International Journal of Logistics Research and Applications*, *25*(2), 119-142. https://doi.org/10.1080/13675567.2020.1803246

[22] Flechsig, C., Anslinger, F., & Lasch, R. (2022). Robotic Process Automation in purchasing and supply management: A multiple case study on potentials, barriers, and implementation. *Journal of Purchasing and Supply Management*, *28*(1), 100718. https://doi.org/10.1016/j.pursup.2021.100718

[23] Greer, S. L., Klasa, K., & Van Ginneken, E. (2020). Power and purchasing: why strategic purchasing fails. *The Milbank Quarterly*, *98*(3), 975-1020. https://doi.org/10.1111/1468-0009.12471

[24] Griffin, G., Gaustad, G., & Badami, K. (2019). A framework for firm-level critical material supply management and mitigation. *Resources Policy*, *60*, 262-276. https://doi.org/10.1016/j.resourpol.2018.12.008

[25] Hafsa, F., Darnall, N., & Bretschneider, S. (2022). Social public purchasing: addressing a critical void in public purchasing research. *Public Administration Review*, *82*(5), 818-834. https://doi.org/10.1111/puar.13438

[26] Harrison, A., Skipworth, H., van Hoek, R. I., & Aitken, J. (2019). *Logistics management and strategy*. Pearson UK.

[27] Hazaea, S. A., Al-Matari, E. M., Zedan, K., Khatib, S. F., Zhu, J., & Al Amosh, H. (2022). Green purchasing: Past, present and future. *Sustainability*, *14*(9), 5008. https://doi.org/10.3390/su14095008

[28] Huang, P. L., Lee, B. C., & Chen, C. C. (2019). The influence of service quality on customer satisfaction and loyalty in B2B technology service industry. *Total Quality Management & Business Excellence*, *30*(13-14), 1449-1465. https://doi.org/10.1080/14783363.2017.1372184

[29] Huber, J., & Stuckenschmidt, H. (2020). Daily retail demand forecasting using machine learning with emphasis on calendric special days. *International Journal of Forecasting*, *36*(4), 1420-1438. https://doi.org/10.1016/j.ijforecast.2020.02.005

[30] Jacyna-Gołda, I., Izdebski, M., Szczepański, E., & Gołda, P. (2018). The assessment of supply chain effectiveness. *Archives of Transport*, *45*(1), 43-52. https://doi.org/10.5604/01.3001.0012.0966

[31] Jimenez-Jimenez, D., Martínez-Costa, M., & Sanchez Rodriguez, C. (2019). The mediating role of supply chain collaboration on the relationship between information technology and innovation. *Journal of Knowledge Management*, *23*(3), 548-567. https://doi.org/10.1108/JKM-01-2018-0019

[32] Johannesen, N. J., Kolhe, M., & Goodwin, M. (2019). Relative evaluation of regression tools for urban area electrical energy demand forecasting. *Journal of cleaner production*, *218*, 555-564. https://doi.org/10.1016/j.jclepro.2019.01.108

[33] Johnsen, T., Le Dain, M. A., Kiratli, N., & Schiele, H. (2022). Purchasing and innovation: Past, present and future of the field of research. *Journal of Purchasing and Supply Management*, *28*(2), 100768. https://doi.org/10.1016/j.pursup.2022.100768

[34] Juettner, U., Windler, K., Podleisek, A., Gander, M., & Meldau, S. (2020). Implementing supplier management strategies for supply chain sustainability risks in multinational companies. *The TQM Journal*, *32*(5), 923-938. https://doi.org/10.1108/TQM-05-2019-0136

[35] Júnior, J. R. D. O., Limongi, R., Lim, W. M., Eastman, J. K., & Kumar, S. (2023). A story to sell: The influence of storytelling on consumers' purchasing behavior. *Psychology & Marketing*, *40*(2), 239-261. https://doi.org/10.1002/mar.21758

[36] Kähkönen, A. K., & Patrucco, A. S. (2022). Guest Editorial: A purchasing and supply management view of supply resilience for better crisis response. *Journal of Purchasing and Supply Management*, *28*(5), 100803. https://doi.org/10.1016/j.pursup.2022.100803

[37] Kilimci, Z. H., Akyuz, A. O., Uysal, M., Akyokus, S., Uysal, M. O., Atak Bulbul, B., & Ekmis, M. A. (2019). An improved demand forecasting model using deep learning approach and proposed decision integration strategy for supply chain. *Complexity*, *2019*(1), 9067367. https://doi.org/10.1155/2019/9067367

[38] Kulshrestha, A., Krishnaswamy, V., & Sharma, M. (2020). Bayesian BILSTM approach for tourism demand forecasting. *Annals of tourism research*, *83*, 102925. https://doi.org/10.1016/j.annals.2020.102925

[39] Kurniawan, R., Zailani, S. H., Iranmanesh, M., & Rajagopal, P. (2017). The effects of vulnerability mitigation strategies on supply chain effectiveness: risk culture as moderator. *Supply Chain Management: An International Journal*, *22*(1), 1-15. https://doi.org/10.1108/SCM-12-2015-0482

[40] Law, R., Li, G., Fong, D. K. C., & Han, X. (2019). Tourism demand forecasting: A deep learning approach. *Annals of tourism research*, *75*, 410-423. https://doi.org/10.1016/j.annals.2019.01.014

[41] Lecerf, M., & Omrani, N. (2020). SME internationalization: The impact of information technology and innovation. *Journal of the Knowledge Economy*, *11*(2), 805-824.

[42] Lee, S. M., & Lee, D. (2020). "Untact": a new customer service strategy in the digital age. Service Business, 14(1), 1-22. https://doi.org/10.1007/s11628-019-00408-2

[43] Li, G. (2022). Supply Chain Efficiency and Effectiveness Management Using Decision Support Systems. *International Journal of Information Systems and Supply Chain Management (IJISSCM)*, *15*(4), 1-18. https://doi.org/10.4018/IJISSCM.305847

[44] Li, H., Zhang, Y., & Li, Y. (2024). The impact of the digital economy on the total factor productivity of manufacturing firms: Empirical evidence from China. Technological Forecasting and Social Change, 207, 123604.

[45] Lyu, X., Pang, Z., & Xu, Y. (2024). Has the digital transformation promoted energy-saving-biased technological progress in China's manufacturing sector?. Applied Economics, 1-18.

[46] Merkuryeva, G., Valberga, A., & Smirnov, A. (2019). Demand forecasting in pharmaceutical supply chains: A case study. *Procedia Computer Science*, *149*, 3-10. https://doi.org/10.1016/j.procs.2019.01.100

[47] Miśkiewicz, R. (2021). The impact of innovation and information technology on greenhouse gas emissions: a case of the Visegrád countries. *Journal of Risk and Financial Management*, *14*(2), 59. https://doi.org/10.3390/jrfm14020059

[48] Mulchandani, K., Jasrotia, S. S., & Mulchandani, K. (2023). Determining supply chain effectiveness for Indian MSMEs: A structural equation modelling approach. *Asia Pacific Management Review*, *28*(2), 90-98. https://doi.org/10.1016/j.apmrv.2022.04.001

[49] Murfield, M. L. U., Ellram, L. M., & Giunipero, L. C. (2021). Moving purchasing & supply management beyond a cost-focused identity. *Journal of Purchasing and Supply Management*, *27*(3), 100687. https://doi.org/10.1016/j.pursup.2021.100687

[50] Nakagawa, Y. (2020). Taking a future generation's perspective as a facilitator of insight problem-solving: Sustainable water supply management. *Sustainability*, *12*(3), 1000. https://doi.org/10.3390/su12031000

[51] Nechaev, A., Skorobogatova, Y., & Nechaeva, M. (2021). Toolkit for the transportation and logistics infrastructure. *Transportation Research Procedia*, *54*, 637-644. https://doi.org/10.1016/j.trpro.2021.02.116

[52] Nguyen, D., Nguyen, T., Nguyen, X., Do, T., & Ngo, H. (2022). The effect of supply chain finance on supply chain risk, supply chain risk resilience, and performance of Vietnam SMEs in global supply chain. *Uncertain Supply Chain Management*, *10*(1), 225-238. http://dx.doi.org/10.5267/j.uscm.2021.9.005

[53] Nyagadza, B., Muposhi, A., Mazuruse, G., Makoni, T., Chuchu, T., Maziriri, E. T., & Chare, A. (2024). Prognosticating anthropomorphic chatbots' usage intention as an e-banking customer service gateway: cogitations from Zimbabwe. *PSU Research Review*, *8*(2), 356-372. https://doi.org/10.1108/PRR-10-2021-0057

[54] Okoye, C. C., Ofodile, O. C., Tula, S. T., Nifise, A. O. A., Falaiye, T., Ejairu, E., & Addy, W. A. (2024). Risk management in international supply chains: A review with USA and African Cases. *Magna Scientia Advanced Research and Reviews*, *10*(1), 256-264. https://doi.org/10.30574/msarr.2024.10.1.0024

[55] Onstein, A. T., Tavasszy, L. A., & Van Damme, D. A. (2019). Factors determining distribution structure decisions in logistics: a literature review and research agenda. *Transport Reviews*, *39*(2), 243-260. https://doi.org/10.1080/01441647.2018.1459929

[56] Rita, P., Oliveira, T., & Farisa, A. (2019). The impact of e-service quality and customer satisfaction on customer behavior in online shopping. *Heliyon*, *5*(10). https://doi.org/10.1016/j.heliyon.2019.e02690

[57] Rivaldo, Y., & Amang, A. (2022). Influence of Marketing Strategy, Trust, and Perception Service Quality of Purchasing Decisions. *Jurnal Manajemen dan Kewirausahaan*, *2*(1), 99-103. https://doi.org/10.36352/jumka.v2i1.335

[58] Sah, B., Gupta, R., & Bani-Hani, D. (2021). Analysis of barriers to implement drone logistics. *International Journal of Logistics Research and Applications*, *24*(6), 531-550. https://doi.org/10.1080/13675567.2020.1782862

[59] Schaffer, H. D., & Ray, D. E. (2020). Agricultural supply management and farm policy. *Renewable Agriculture and Food Systems*, *35*(4), 453-462. https://doi.org/10.1017/S1742170518000595

[60] Schiele, H. (2019). Purchasing and supply management. *Operations, logistics and supply chain management*, 45-73. https://doi.org/10.1007/978-3-319-92447-2_4

[61] Seyedan, M., & Mafakheri, F. (2020). Predictive big data analytics for supply chain demand forecasting: methods, applications, and research opportunities. Journal of Big Data, 7(1), 53. https://doi.org/10.1186/s40537-020-00329-2

[62] Sgarbossa, F., Grosse, E. H., Neumann, W. P., Battini, D., & Glock, C. H. (2020). Human factors in production and logistics systems of the future. *Annual Reviews in Control*, *49*, 295-305. https://doi.org/10.1016/j.arcontrol.2020.04.007

[63] Sheehan, B., Jin, H. S., & Gottlieb, U. (2020). Customer service chatbots: Anthropomorphism and adoption. *Journal of Business Research*, *115*, 14-24. https://doi.org/10.1016/j.jbusres.2020.04.030

[64] Sheikh, A., Anderson, M., Albala, S., Casadei, B., Franklin, B. D., Richards, M., ... & Mossialos, E. (2021). Health information technology and digital innovation for national learning health and care systems. *The Lancet Digital Health*, *3*(6), e383-e396. https://doi.org/10.1016/S2589-7500(21)00005-4

[65] Shou, Y., Shao, J., Lai, K. H., Kang, M., & Park, Y. (2019). The impact of sustainability and operations orientations on sustainable supply management and the triple bottom line. *Journal of Cleaner Production*, *240*, 118280. https://doi.org/10.1016/j.jclepro.2019.118280

[66] Song, H., Qiu, R. T., & Park, J. (2019). A review of research on tourism demand forecasting: Launching the Annals of Tourism Research Curated Collection on tourism demand forecasting. *Annals of tourism research*, *75*, 338-362. https://doi.org/10.1016/j.annals.2018.12.001

[67] Soyer, M., & Dittrich, K. (2021). Sustainable consumer behavior in purchasing, using and disposing of clothes. *Sustainability*, *13*(15), 8333. https://doi.org/10.3390/su13158333

[68] Srai, J. S., & Lorentz, H. (2019). Developing design principles for the digitalisation of purchasing and supply management. *Journal of Purchasing and Supply Management*, *25*(1), 78-98. https://doi.org/10.1016/j.pursup.2018.07.001

[69] Sutrisno, S., Kuraesin, A. D., Siminto, S., Irawansyah, I., & Ausat, A. M. A. (2023). The Role of Information Technology in Driving Innovation and Entrepreneurial Business Growth. *Jurnal Minfo Polgan*, *12*(1), 586-597. https://doi.org/10.33395/jmp.v12i1.12463

[70] Tang, C. S., & Veelenturf, L. P. (2019). The strategic role of logistics in the industry 4.0 era. *Transportation Research Part E: Logistics and Transportation Review*, *129*, 1-11. https://doi.org/10.1016/j.tre.2019.06.004

[71] Tantoh, H. B., & McKay, T. J. (2020). Rural self-empowerment: The case of small water supply management in Northwest, Cameroon. *GeoJournal*, *85*(1), 159-171. https://doi.org/10.1007/s10708-018-9952-6

[72] Tijan, E., Aksentijević, S., Ivanić, K., & Jardas, M. (2019). Blockchain technology implementation in logistics. *Sustainability*, *11*(4), 1185. https://doi.org/10.3390/su11041185

[73] van Hoek, R., Sankararaman, V., Udesen, T., Geurts, T., & Palumbo-Miele, D. (2020). Where we are heading and the research that can help us get there–executive perspectives on the anniversary of the Journal of Purchasing and Supply Management. *Journal of Purchasing and Supply Management*, *26*(3), 100621. https://doi.org/10.1016/j.pursup.2020.100621

[74] Wilson, A., Zeithaml, V., Bitner, M. J., & Gremler, D. (2020). *EBK: Services Marketing: Integrating Customer Service Across the Firm 4e*. McGraw Hill.

[75] Winkelhaus, S., & Grosse, E. H. (2020). Logistics 4.0: a systematic review towards a new logistics system. International Journal of Production Research, 58(1), 18-43. https://doi.org/10.1080/00207543.2019.1612964

[76] Xie, W., Zheng, D., Li, Z., Wang, Y., & Wang, L. (2024). Digital technology and manufacturing industrial change: Evidence from the Chinese manufacturing industry. Computers & Industrial Engineering, 187, 109825.

[77] Xu, L., Prybutok, V., & Blankson, C. (2019). An environmental awareness purchasing intention model. *Industrial Management & Data Systems*, *119*(2), 367-381. https://doi.org/10.1108/IMDS-12-2017-0591

[78] Yao, L., & Jin, M. (2024). Impacts of green taxation on the green transformation of manufacturing industry: an empirical analysis based on Chinese provincial panel data. Economic Change and Restructuring, 57(1), 4.

[79] Yavas, V., & Ozkan-Ozen, Y. D. (2020). Logistics centers in the new industrial era: A proposed framework for logistics center 4.0. *Transportation Research Part E: Logistics and Transportation Review*, *135*, 101864. https://doi.org/10.1016/j.tre.2020.101864

[80] Zhao, S., Guan, Y., Zhou, H., & Hu, F. (2024). Making digital technology innovation happen: The role of the CEO's information technology backgrounds. *Economic Modelling*, *140*, 106866. https://doi.org/10.1016/j.econmod.2024.106866